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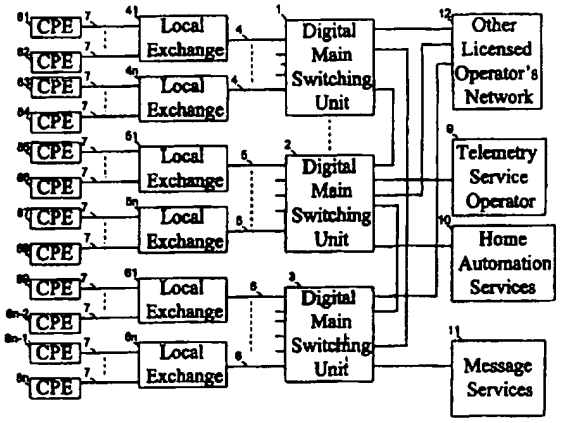

(57) Abstract

In a telecommunications network of the kind which handles non-time-critical calls (NTCC) in addition to normal telephony, a congestion indication is transmitted to NTCC transmitting platforms if volume and/or rate limit for a particular communications route or switch is exceeded. Transmitting platforms (9, 10, 11) establish a transmission rate based on a gaping rate (GR). On receipt of a congestion signal the platforms calculate an Inter call delay based on a random number multipled by a weighting factor determined from the current value of GR. This provides a period during which calls are not attempted after which GR is adjusted using a common ratio to provide a higher value of GR thus transmission rate (or the rate at which calls are offered) to the congestion route is less onerous. Consecutive call failures result in a rapid increase in the value of GR leading to longer ICDs (to allow the congested route/switch to recover) and a lower traffic loading on recovery. Further, multiple transmitting platforms resume sending at different times due to randomisation of ICDs across platforms.

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TELECOMMUNICATIONS NETWORKS

The present invention relates to telecommunications networks and more particularly to such networks of the kind adapted to provide non intrusive telephony related services to customers premises.

The public switched telecommunications network (PSTN) has developed from a system which carries only voice communication to one adapted to carry facsimile messages and data communications. Much of this development was accomplished using space switching techniques and analogue signalling in which end-to-end communication was, to all intents and purposes, along a pair of dedicated wires for the duration of the end-to-end communication.

The quality of communication was improved by for example digitising speech signals using pulse code modulation for example so that deterioration of the analogue signal due to resistive and capacitive effects could be compensated for making communication over much longer distances possible. Once digitalisation of speech signals became common practice part of the communications network could be more effectively used by compressing several calls onto one main communication route using time division multiplexing techniques. Initially most of the switching was still carried out using space division techniques physically switching the connection between one pair of wires and another.

Further development in digital switching techniques lead to substantially improved networks and the major PSTN in the United Kingdom is substantially digital from the local exchange. In a digital network it is possible to provide many more services to end customers. For example by using techniques to activate terminals at the customer's premises selectively and without effecting alert of customer telephones or related equipment responsive to a ringing current, telemetry, remote control, messaging and other services can be provided.

As the number of such services grow for example telemetry operations may be provided by a number of different operators, the possibility of a focused overload on a particular route increases. Thus if coincidentally gas, water and or electricity meter reading requests together with advertising to messaging terminals were to arrive in a very short period of time at one particular exchange telephony

service could be adversely degraded by the presence of non-time critical service offering.

Where the network operator is the sole provider of non-time critical services such a clash can be avoided by the network operators own management systems ensuring that the distribution of such calls is reasonable having regard to normal telephony demands of local exchanges. However, regulation and competitive service requirements of such regulations to avoid monopoly misuse require PSTN operators to grant network access to other licensed network operators (OLOs).

Similarly, where competing PSTN services are offered by several network operators in a locality the telemetry service operator on one network will require access to persons whose lines appear only on another network so that a complete service can be provided for all potential customers. As call distribution capability moves away from a particular PSTN operator then some method of restricting focused overload is required.

According to the present invention there is provided a telecommunications network comprising a plurality of switching units interconnected to provide telephony service to customers and having network access points for a plurality of service platforms providing Non-Time Critical Communication (NTCC) services characterised in that each switching unit is allocated a volumetric limit for NTCCs and, on receipt of a NTCC which causes the limit to be exceeded, transmits a congestion indication to the originating service platform, each service platform on receipt of a congestion indication commencing a time out determined by a multiplying a random number (RN) by a weighting factor (W) determined from a current gapping rate (GR) to produce a value of intercall delay (ICD) which determines a period during which the service platform offers no NTCCs to the congested switching unit.

Preferably the value of GR is compared against upper and lower band limits of a series of bands each band providing a respective W which substantially increases the period during which NTCCs are not attempted.

Each platform offers NTCCs to a switching unit sequentially at a rate determined by GR and after expiry of the period determined by ICD the value of GR

is adjusted so that the period between sequential calls from the respective platform is increased.

After "N" successful offerings of NTCCs by a platform (where N is an integer of at least one) the value of GR may be adjusted so that the period between sequential call offerings is reduced. The value of GR may be bounded to limit the maximum rate of call offering or the maximum value of ICD.

A feature of the invention provides a telecommunications service platform which generates non time critical calls including control means responsive to a congestion indication received from a telecommunications network to restrict or delay the offering of NTCCs to specified destinations of the network.

A telecommunications network in accordance with the invention will now be described with reference to the accompanying drawing which shows a telecommunications network. Referring to the drawing a typical PSTN comprises a multiplicity of Digital Main Switching Units (DMSUs) represented by DMSUs 1, 2 and 3. Each DMSU is connected to a plurality of local exchanges 4/1 to 4/n, 5/1 to 5/n, 6/1 to 6/n which exchanges are connected to provide individual telephony service through local lines 7 to customer premises equipment 8/1 to 8/n.

As so far described the system is representative of many digital switched telecommunications networks. However, some digital networks, for example that provided by BT in the United Kingdom habve the ability to use C7 signalling across the network to indicate to the local exchanges that a call being offered is of the no ring type, that is a call connection by way of the local loop 7 to customer premise equipment which can be alerted by use of line reversal and/or current signalling techniques. Networks of this kind are discussed in our co-pending patent application number PCT/GB95/00853

An advantage of this kind of facility is that the network operator may offer access to the customer premises for connection to specialised equipment such as meter reading units, messaging terminals ETG E-mail display terminals or other services such as that disclosed in co-pending patent application number GB960096.3.

Other operators of similar services for example an independent telemetry service operator 9 or home automation service 10 or message service provider 11 may request access to customers of the PSTN operator. Further, other licensed

operators 12 having network access through DMSUs 1, 2 and 3 may have similar service operators (not shown) accessing the network through the OLO access.

It will be appreciated that these reciprocal arrangements between major network operators are required in order to provide a complete service to e.g. telemetry service operator 9 otherwise customers of the service will need to subscribe to a service on each network. Thus reciprocal arrangements between network operators through interconnection agreements are usually put into place.

Telemetry service and certain message services (e.g. advertising services) and some home automation type accesses are normally of a non-time critical nature. In practice where the PSTN operator provides a telemetry service to other utilities for example to electricity, gas or water suppliers it is usual for the non time critical access to the CPE or meter reading to be carried out at quiet periods. This avoids causing serious network congestion. Further, where the PSTN operator is also a service provider a network management system is able to pin point areas of congestion within the network so that non time critical communications are not made through congested exchanges.

Once access control through the DMSUs 1, 2 and 3 is granted to other operators of non time critical services then a more specific control of these services is required since more than one of the service platforms 9, 10 and 11, either directly of through the other licensed operators network 12, will be seeking to access the same local switching group at the same time.

Now assuming that each of the local exchanges, 41-4N, 51-5N, 61-6n has a control unit responsive to C7 signalling from its DMSU 1 by way of a digital trunk route 4, 5, 6 each local exchange control unit has a rate limit and a maximum volume set. A rate limit determines the maximum number of calls per minute which the exchange will handle while the volume limit determines the maximum of calls which may be progress at the same time. Similarly, the DMSU will have for each of the routes say 4, a rate and volume limit.

Where either the local exchange say 41 or the DMSU 1 respectively determines that a call offered by e.g. the telemetry service platform 9 for one of the customers 81, 82 will cause the volume or rate limit to be exceeded it will return C7 signalling indicative of congestion.

If the respective service platform 9, 10 and 11 receives an exchange congestion signal while attempting a call to a particular local exchange call 1 the congestion back up algorithm is applied. For the purposes of description each of the platforms 9, 10 and 11 is referred to as a TP and within the TP up to the point at which the congestion signal is received from the network call rate limiting is applied on a per local exchange for example on the basis of the expression call gapping rate equals k/n where n is an integer and k is a constant in which k/n when rounded up to the nearest 100 millisecond period defines the period between successive non-critical call offerings to the respective local exchange 41. In the United Kingdom k is 5 since the force release period adopted by the main PSTN operator is 5 seconds. The invention is not however limited to such a period.

On receipt of line congestion control means within the TP determines a random number based on a seed of 10 (e.g. RND 10). Using the current intercall gapping rate (GR) the control now applies the random number in accordance with the following table.

Current Call Gapping (GR) in seconds for congested DLE	Delay to next call attempt
0 < GR < 1	RND (10) X 0.1 sec
1< GR< 10	RND (10) x 1 sec
10< GR < 100	RND (10) x 10 sec
100< GR< 1000	RND (10) x 100 sec

The application of a random number based on a seed ensures that if several service platforms are transmitting to a particular local exchange 41 and each receives a back off congestion signal at the same time the platforms each attempt to connect a non time critical call after a different delay.

After applying the delay described above the TP resumes offering calls to the local exchange 41 but with a longer delay period namely 2 x 5/n or 10/n second intercall delay. Thus the rate of which calls are now offered by the respective TP to the local exchange is half that of the attempt rate prior to receiving congestion indication. Further failures will result in a geometric increase in GR with a common factor of 2.

If after applying the call delay and before further modification of GR a further congestion indication is received a new intercall delay is calculated as described in accordance with the table above and is applied prior to attempting to resume calling at 50% of the new prevailing rate.

Thus each time successive call attempts result in congestion indication being returned either from a DMSU or from a local exchange the period before a further call is offered by the respective TP to the respective local exchange increases and the rate at which successive calls are offered is reduced.

As the resumption of calling from a number of TPs is staggered by virtue of the random number then the build up of non-time critical traffic through a local exchange is staggered when congestion caused by the volume or rate limit excess has cleared.

Once a telephony platform has succeeded in offering a number of calls successfully to the same local exchange say 41 without further congestion occurring then the rate at which calls are offered may be progressively doubled until the value of GR reaches the predetermined value of 5 over n.

Note that the maximum value of GR is limited so that after the intercall delay of RND (10 x100) has been applied if the gapping rate exceed 999 seconds then the period between calls will not be further increased as a result of additional congestion messages.

The algorithm above has more than one source of random behaviour inherent therein as multiple circuit or accesses to the local exchange are possible. As a succession of calls to one of the exchanges which brought about exchange congestion will in general all have been originated at a different time and will have encountered congestion at a different absolute time, the respective intercall delays from different platforms and the period during which calls are not offered from different platforms will vary.

Only small increases in inter call delay occur where short term congestion applies. Where much longer delays are necessary where long-term no ring call volume or connected congestion is encountered reasonably rapid recovery to normal intercall delay occurs when an exchange congestion situation is no longer present. It will be noted that the DMSUs and/or local exchanges may be

programmed to vary the volume and/or rate limit values for non-time critical calls where the presence of telephony or other time critical call volume has increased.

CLAIMS

1. A telecommunications network comprising a plurality of switching units interconnected to provide telephony service to customers and having network access points for a plurality of service platforms providing Non-Time Critical Communication (NTCC) services characterised in that each switching unit is allocated a volumetric limit for NTCCs and, on receipt of a NTCC which causes the limit to be exceeded, transmits a congestion indication to the originating service platform, each service platform on receipt of a congestion indication commencing a time out determined by a multiplying a random number (RN) by a weighting factor (W) determined from a current gapping rate (GR) to produce a value of intercall delay (ICD) which determines a period during which the service platform offers no NTCCs to the congested switching unit.

2. A telecommunications network as claimed in claim 1 further characterised in that the value of GR is compared against upper and lower band limits of a series of bands each band providing a respective W which substantially increases the period during which NTCCs are not attempted.

3. A telecommunications network as claimed in claim 1 or claim 2 further characterised in that each platform offers NTCCs to a switching unit sequentially at a rate determined by GR.

4. A telecommunications network as claimed in claim 3 further characterised in that after expiry of the period determined by ICD the value of GR is adjusted so that the period between sequential calls from the respective platform is increased.

5. A telecommunications network as claimed in claim 4 further characterised in that after "N" successful offerings of NTCCs by a platform (where N is an integer of at least one) the value of GR is adjusted so that the period between sequential call offerings is reduced.

6. A telecommunications network as claimed in claim 5 further characterised in that the value of GR returns to the value held immediately prior to the last received congestion indication.

7. A telecommunications network as claimed in claim 6 further characterised in that after each successive "N" successful offerings of NTCCs the value of GR progressively returns to values held prior to receipt of sequential congestion indications.

8. A telecommunications network as claimed in any preceding claim further characterised in that the value of GR is bounded to limit the maximum rate of call offering.

9. A telecommunications network as claimed in any preceding claim further characterised in that the value of GR is bounded to limit the maximum value of ICD.

10 A telecommunications service platform which generates non time critical calls including control means responsive to a congestion indication received from a telecommunications network to restrict or delay the offering of NTCCs to specified destinations of the network.

11. A telecommunications service platform as claimed in claim 10 further characterised in that on receipt of a congestion indication the control means commences a time out determined by a multiplying a random number (RN) by a weighting factor (W) determined from a current gapping rate (GR) in respect of a congested destination to produce a value of intercall delay (ICD) which determines a period during which the service platform offers no NTCCs to the congested destination.

12. A telecommunications service platform as claimed in claim 11 further characterised in that the value of GR is compared against upper and lower band limits of a series of bands each band providing a respective W which substantially increases the period during which NTCCs are not attempted.

13. A telecommunications service platform as claimed in claim 11 or claim 12 further characterised in that the platform offers NTCCs to a predetermined destination sequentially at a rate determined by GR.

14. A telecommunications service platform as claimed in claim 13 further characterised in that after expiry of the period determined by ICD the value of GR is adjusted so that the period between sequential calls from to the respective destination is increased.

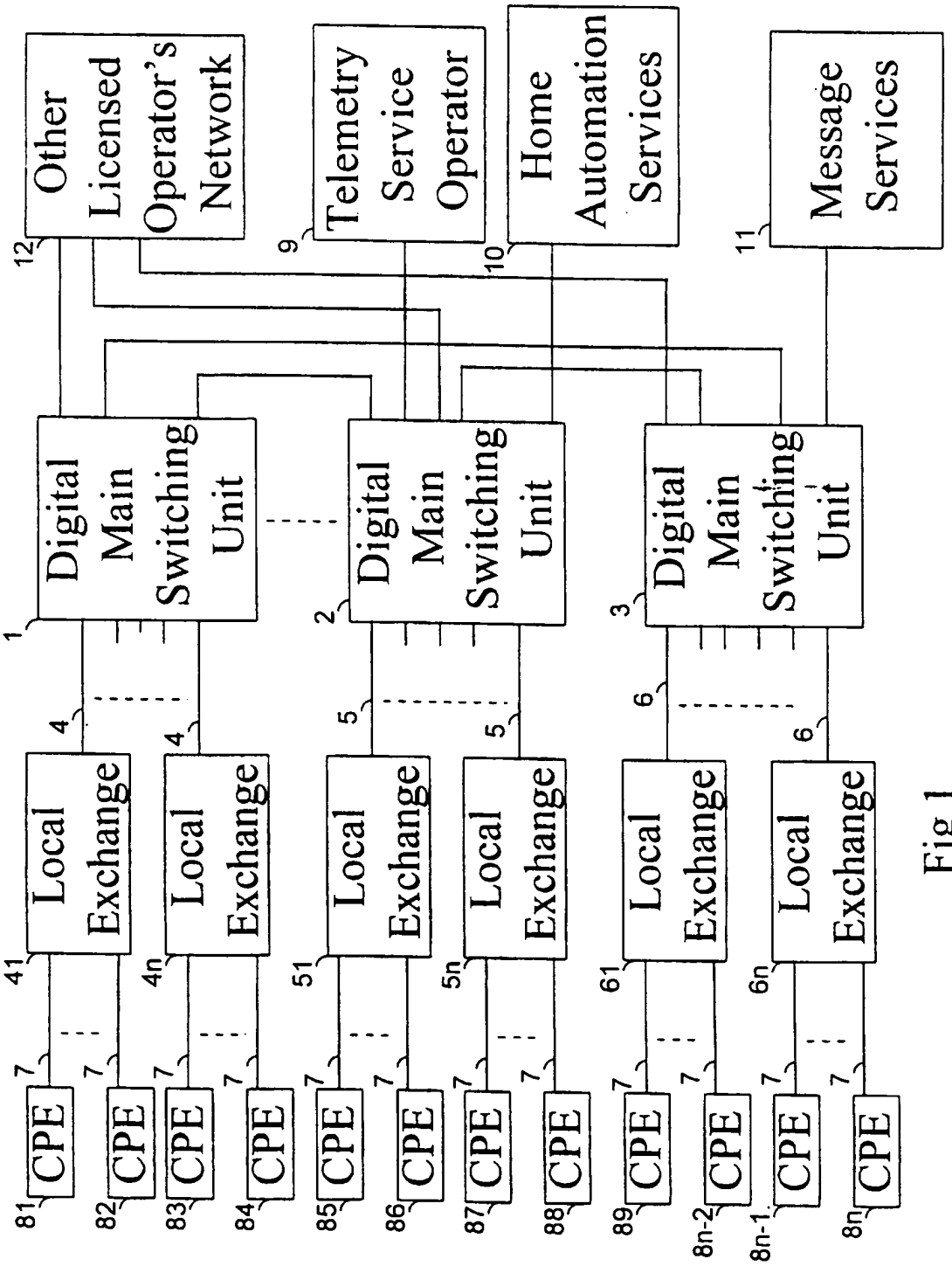
15. A telecommunications service platform as claimed in claim 14 further characterised in that after "N" successful offerings of NTCCs to a previously congested destination (where N is an integer of at least one) the value of GR is adjusted so that the period between sequential call offerings is reduced.

16. A telecommunications service platform as claimed in claim 15 further characterised in that the value of GR returns to the value held immediately prior to the last received congestion indication.

17. A telecommunications service platform as claimed in claim 16 further characterised in that after each successive "N" successful offerings of NTCCs the value of GR progressively returns to values held prior to receipt of sequential congestion indications.

18. A telecommunications service platform as claimed in any one of claims 11 to 17 further characterised in that the value of GR is bounded to limit the maximum rate of call offering.

19. A telecommunications service platform as claimed inany one of claims 11 to 18 further characterised in that the value of GR is bounded to limit the maximum value of ICD.


Other Licensed Operator's Network
12
Telemetry Service Operator
9
Home Automation Services
10
Message Services
11
Digital Main Switching Unit
1
Digital Main Switching Unit
2
Digital Main Switching Unit
3
4
5
6
Local Exchange
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Local Exchange
4n
Local Exchange
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Local Exchange
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Fig 1

INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/GB 97/00558

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q3/00 H04M3/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	EP 0 687 116 A (AT & T) 13 December 1995 see page 3, line 6 - line 22 see column 6, line 47 - line 55 see claims 1,7,9,10,16,17 ---	1,3,10, 11
Y	IEE COLLOQIUM ON "FRAME RELAY" - DIGEST NO 096, 22 April 1992, LONDON (GB), pages 3/1-3/4, XP002010407 A. WATERS ET AL: "Congestion Control for Frame Relay Networks" see page 1, line 12 - line 16 see page 3, line 6 - line 8 --- -/--	1,3,10, 11

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
20 May 1997	02.06.97
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1

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